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Development of an Herbal-Based Liquid Body Cleanser with Antimicrobial Properties

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Abstract:
The purpose of this study is to develop a herbal body wash utilizing powdered extracts of Ocimum tenuiflorum (tulsi) and Azadirachta indica (neem). This composition strives to integrate botanical materials that are deeply rooted in traditional medicine practices with minimal side effects, as Ayurvedic cosmetics are becoming more and more popular due to their natural ingredients. Neem, which is well-known for its medicinal properties, is important. Its anti-inflammatory, antihyperglycemic, antimalarial, and antibacterial properties make it noteworthy. A comprehensive technique is used in the study to examine the effects of various extracts from neem leaves. Neem and Tulsi are used in the carefully made herbal soap, which shows particular effectiveness against dermatophytes while Tulsi has exceptional antiviral qualities. This study highlights the enormous potential of herbal formulations by illuminating the many advantages of neem and tulsi as well as their revolutionary uses in cosmetic products.
Keywords: *Ocimum tenuiflorum, Azadirachta indica, Anti-inflammatory, Antihyperglycemic, Antimalarial, Antibacterial*



Introduction:

The increasing awareness regarding the adverse effects of synthetic chemicals in personal care products has led to a growing interest in herbal-based formulations. Natural ingredients derived from medicinal plants offer a safer and more sustainable alternative due to their biocompatibility and therapeutic properties. Among these, Neem (*Azadirachta indica*) and Tulsi (*Ocimum sanctum*) are well-known for their extensive use in traditional medicine systems, particularly Ayurveda, owing to their antimicrobial, anti-inflammatory, and antioxidant activities.[1] The skin functions as the primary barrier protecting the human body from environmental factors such as dust, pollutants, and pathogenic microorganisms. Continuous exposure to these elements may result in various dermatological conditions including acne, irritation, infections, and premature aging. Therefore, maintaining proper skin hygiene through effective yet gentle cleansing agents is essential for preserving skin health.[2]



Figure 2.1: The Neem and Tulsi body cleanser is a herbal formulation developed using plant-based ingredients

The Neem and Tulsi body cleanser is a herbal formulation developed using plant-based ingredients, as shown in **Figure 2.1**. The formulation incorporates key bioactive components derived from Neem and Tulsi, which contribute to its therapeutic efficacy. Unlike conventional soaps that may disrupt the skin's natural lipid barrier and cause dryness, this herbal cleanser is designed to provide mild cleansing while maintaining skin hydration. The preparation of the cleanser follows a systematic procedure to ensure uniform mixing and stability of the formulation.[3]

Neem is known for its strong antibacterial and antifungal properties, which help in reducing acne-causing microorganisms and preventing skin infections. Tulsi, on the other hand, exhibits anti-inflammatory and antioxidant effects that assist in soothing irritated skin and protecting against oxidative stress. The synergistic action of these ingredients enhances the overall performance of the body cleanser, making it effective in cleansing, purifying, and protecting the skin.[4]

In addition to Neem and Tulsi, herbal formulations may include other natural ingredients such as aloe vera, honey, and sandalwood to improve moisturizing, soothing, and skin-brightening properties. The general method of preparing herbal body wash involves extraction of plant materials, blending with mild surfactants, and stabilization of the formulation. The final product exhibits desirable characteristics such as appropriate viscosity, good foaming ability, and aesthetic appeal.[5] Furthermore, herbal body washes can be modified for specific applications such as de-tanning. De-tan formulations typically incorporate natural ingredients like coffee, lemon, aloe vera, and turmeric, which provide exfoliating, brightening, and nourishing effects. These formulations help in reducing pigmentation and restoring natural skin tone without the use of harsh chemicals.[6] Overall, herbal body cleansers represent an effective and skin-friendly alternative to conventional cleansing products. Their ability to combine cleansing action with therapeutic benefits makes them suitable for daily use, particularly for individuals with sensitive or acne-prone skin. Regular use of such formulations can contribute to improved skin health, enhanced appearance, and long-term protection against environmental damage.[7]

Comparison: Neem and Tulsi Body Cleanser versus Basic Soap

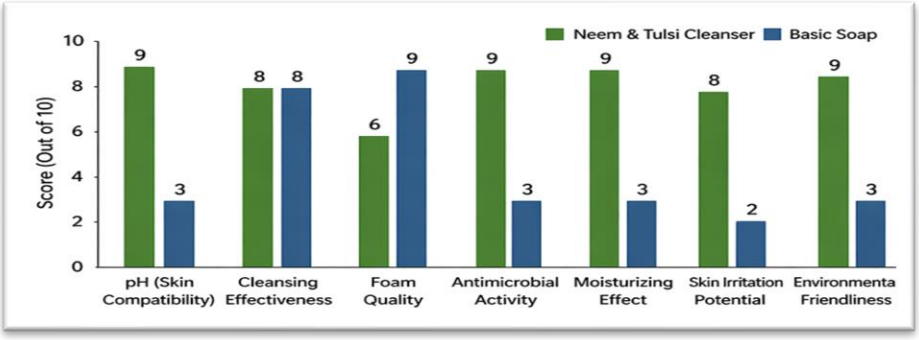


***Figure 1.1*: Comparative evaluation of Neem and Tulsi herbal body cleanser and basic soap based on various parameter**

A comparative evaluation was performed between the formulated herbal body cleanser containing neem (*Azadirachta indica*) and tulsi (*Ocimum sanctum*) extracts and a conventional basic soap formulation. The comparison was based on physicochemical properties, skin compatibility, antimicrobial efficacy, and overall performance.[8]

Composition and Functional Characteristics

The herbal cleanser is composed of plant-derived ingredients, including neem and tulsi extracts, aloe vera, and natural surfactants such as reetha (*Sapindus mukorossi*). These ingredients provide multiple functional benefits such as antimicrobial activity, skin soothing, and hydration.[9]

In contrast, basic soaps are typically prepared using synthetic or semi-synthetic surfactants and may contain additives such as sodium lauryl sulfate (SLS), artificial fragrances, and preservatives. These components primarily focus on cleansing but may lack additional therapeutic benefits.[10]

Parameter	Neem & Tulsi Cleanser	Basic Soap
Source of Ingredients	Natural (Herbal extracts, plant-based)	Synthetic / Semi-synthetic chemicals
pH	5.5 – 6.5 (Skin-friendly)	9 – 10 (Alkaline)
Foam Formation	Mild to moderate (Gentle foam)	High (Abundant foam)
Antimicrobial Activity	High (Natural bioactives)	Low to moderate (Mechanical cleaning)
Moisturizing Effect	High (Aloe vera, glycerin)	Low (Lack of moisturizers)
Skin Irritation	Minimal	Possible (Dryness, irritation)
Environmental Impact	Biodegradable, Eco-friendly	Less biodegradable, Pollution potential

***Figure 1.2:* Comparison of Neem and Tulsi herbal body cleanser with basic soap**

pH and Skin Compatibility

The pH of the neem–tulsi cleanser was found to be within the range of **5.5–6.5**, which closely matches the natural pH of human skin. This helps in maintaining the skin barrier and preventing dryness or irritation.

Basic soaps generally exhibit an alkaline pH (approximately **9–10**), which can disrupt the acid mantle of the skin, leading to dryness, irritation, and increased susceptibility to infections.[11]

Cleansing and Foaming Properties

The herbal cleanser demonstrated mild to moderate foam formation due to the presence of natural saponins from reetha. This provides gentle cleansing without excessive removal of natural oils.

Basic soaps produce abundant foam due to synthetic surfactants, which may lead to over-cleansing and stripping of essential lipids from the skin.[12]

Antimicrobial Activity

The neem–tulsi formulation exhibited significant antimicrobial activity against common skin pathogens such as *Staphylococcus aureus* and *Escherichia coli*. This effect is attributed to bioactive compounds such as flavonoids, terpenoids, and essential oils present in neem and tulsi.

Basic soaps may show limited antimicrobial activity unless specifically medicated, and their effect is primarily based on mechanical cleansing rather than biochemical inhibition.[12-13]

Moisturizing and Skin Benefits

The presence of aloe vera and glycerin in the herbal formulation enhances skin hydration, reduces irritation, and provides a soothing effect.

Basic soaps often lack moisturizing agents and may leave the skin feeling dry and rough after repeated use.[14]

Environmental Impact

Herbal cleansers are biodegradable and environmentally friendly due to their natural composition.

Basic soaps containing synthetic chemicals may contribute to environmental pollution and are less biodegradable.[15]

Methodology:

1 Materials

Neem extract (Azadirachta indica), tulsi extract (Ocimum sanctum), aloe vera gel (Aloe barbadensis), and turmeric extract (Curcuma longa) were procured from certified commercial suppliers. A natural liquid soap base was employed as the primary surfactant. Glycerin was used as a humectant to enhance moisture retention, while essential oils were incorporated to impart fragrance. All materials and chemicals used in the formulation were of analytical grade and utilized without further purification.

2 Formulation Composition

Component	Quantity (%)
Neem extract	5
Tulsi extract	5
Aloe vera gel	10
Turmeric extract	2
Liquid soap base	60
Glycerin	5
Essential oil	q.s.
Distilled water	up to 100

Table 2.1: Formulation Composition

3 Preparation Method

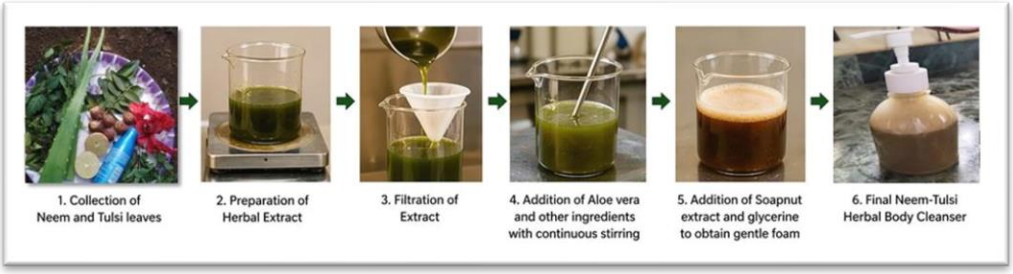


Figure 2,1: Preparation of Neem and Tulsi Herbal Body Cleanser

1 Preparation of Herbal Liquid Cleanser

The formulation of the herbal liquid cleanser was carried out using a systematic mixing process to ensure homogeneity and stability. Initially, the extracts of *Alternanthera sessilis* and orange peel were combined in a predetermined ratio to obtain a thick, semisolid base. This step facilitates the incorporation of bioactive phytoconstituents such as flavonoids and phenolic compounds shown in ***figure 2.1***. Subsequently, freshly prepared aloe vera extract was added to the above mixture. The blend was subjected to continuous stirring to ensure uniform distribution and proper integration of the moisturizing components. Thereafter, the aqueous extract of soap nut (*Sapindus mukorossi*), a natural surfactant rich in saponins, was gradually incorporated into the mixture. This resulted in the formation of a homogeneous system with mild foaming characteristics. Glycerin was then added as a humectant to enhance skin hydration and improve the texture of the formulation. The pH of the formulation was adjusted using suitable pH modifiers to maintain it within a skin-compatible range (approximately 5.5–6.5), thereby minimizing the risk of irritation. Finally, a small quantity of essential oil was added to impart a pleasant fragrance, followed by the addition of a suitable preservative to enhance microbial stability and extend the shelf life of the product. The final formulation was mixed thoroughly and stored in airtight containers for further evaluation.[16-18]

Literature Review:

1 Overview of Herbal Body Wash versus Synthetic Body Wash

Recent studies highlight a significant shift in consumer preference from synthetic cleansing products toward herbal-based formulations. Conventional body washes commonly contain surfactants such as sodium lauryl sulfate (SLS)

and preservatives like parabens, which are associated with skin irritation, dryness, and disruption of the natural skin barrier. These synthetic agents may also alter the skin's microbiome and pH balance.

In contrast, herbal body washes are formulated using plant-derived ingredients, including vegetable oils (e.g., coconut, olive, and palm oils) and natural extracts. Such formulations are biodegradable, eco-friendly, and more compatible with the physiological pH of the skin. According to Saha et al., herbal cleansers provide gentle cleansing while maintaining skin hydration and integrity, making them suitable for long-term use.

2 Scientific Basis of De-tanning and Exfoliation

Skin tanning occurs due to increased production of melanin in response to ultraviolet (UV) radiation exposure. Melanin synthesis is primarily regulated by the enzyme tyrosinase. Herbal formulations targeting de-tanning mechanisms typically act through two major pathways:

Tyrosinase inhibition: Certain plant-based compounds, such as flavonoids and polyphenols, inhibit tyrosinase activity, thereby reducing melanin synthesis and preventing hyperpigmentation.

Physical exfoliation: Natural exfoliants help remove the outermost layer of dead skin cells (stratum corneum), which contain accumulated melanin. This process reveals brighter and more even-toned skin underneath.

Herbal ingredients such as turmeric, lemon extracts, and aloe vera are widely reported to support these mechanisms through their antioxidant and skin-renewing properties.

3 Key Herbal Ingredients and Their Functional Properties

Various plant-based ingredients have been extensively studied for their role in herbal cosmetic formulations:

Neem and Tulsi: Known for their strong antimicrobial, antifungal, and anti-inflammatory properties, making them effective in preventing skin infections.

Aloe vera: Acts as a natural moisturizer and soothing agent, promoting hydration and skin healing.

Turmeric: Contains curcumin, which exhibits antioxidant, anti-inflammatory, and skin-brightening properties.

Reetha (*Sapindus mukorossi*): A natural surfactant rich in saponins, responsible for mild foaming and cleansing action.

Multani mitti (Fuller's earth): Absorbs excess oil and impurities, aiding in deep cleansing.

Coffee powder: Contains phenolic compounds that provide antioxidant activity and mild exfoliation.

Rice flour and sugar: Serve as natural exfoliating agents.

Coconut oil, honey, and rose water: Provide moisturizing, nourishing, and soothing effects on the skin.

The combination of these ingredients enhances the overall efficacy of herbal body wash formulations by providing cleansing, antimicrobial, exfoliating, and moisturizing benefits.

4 Antimicrobial and Antioxidant Activity

Several studies have reported that herbal formulations exhibit significant antimicrobial activity against common skin pathogens. For instance, research by Koushik et al. demonstrated that herbal soaps containing plant extracts showed notable zones of inhibition against *Staphylococcus aureus* and other microorganisms.

Additionally, herbal ingredients such as coffee, turmeric, and neem are rich in phenolic compounds and antioxidants. These compounds play a crucial role in neutralizing free radicals, thereby reducing oxidative stress, which is a major contributor to premature skin aging, pigmentation, and dullness.

5 Formulation Challenges

Despite their advantages, herbal formulations present certain challenges. The variability in plant extract composition, stability issues, and shorter shelf life compared to synthetic products are key concerns. Maintaining consistency in color, fragrance, and viscosity can be difficult due to the natural origin of ingredients.

Moreover, achieving optimal preservation without the use of synthetic preservatives requires careful selection of natural alternatives. Standardization of herbal extracts and ensuring reproducibility remain important aspects for large-scale production and commercialization.

Result and Discussion:

Category	Parameter	Result/Observation	Interpretation
Organoleptic Properties	Appearance	Homogeneous liquid	Indicates proper formulation
	Color	Greenish-brown	Presence of herbal extracts
	Odor	Pleasant herbal	Acceptable sensory property
	Texture	Smooth	Good consistency
	Clarity	No particulate matter	Uniform dispersion
Physicochemical Properties	pH	6.0–6.5	Skin-friendly, non-irritant
	Viscosity	Moderate	Easy application
	Foamability	Mild and stable foam	Gentle cleansing action
Stability Study	4°C (30 days)	No change	Stable
	25°C (30 days)	No change	Stable
	40°C (30 days)	No change	Stable
	Color/odor/pH	No significant variation	Good shelf stability
	Phase separation	Not observed	Physically stable
Antimicrobial Activity	Staphylococcus aureus	18 mm inhibition	Strong activity

	Escherichia coli	15 mm inhibition	Moderate activity
	Candida albicans	14 mm inhibition	Moderate activity
Comparative Analysis	pH	6.0–6.5 (Herbal) vs 9–10 (Soap)	Herbal is skin-compatible
	Skin compatibility	High (Herbal)	Less irritation
	Antimicrobial effect	Higher in herbal	Better protection
	Moisturizing effect	Good (aloe vera, glycerin)	Prevents dryness
	Foam formation	Mild (Herbal) vs High (Soap)	Gentle cleansing
	Irritation potential	Minimal (Herbal)	Safer for skin
	Environmental impact	Eco-friendly	Biodegradable

Table 4.1. Comprehensive Evaluation of Herbal Body Cleanser

Table 4.1 presents a comprehensive evaluation of the formulated herbal body cleanser in terms of organoleptic characteristics, physicochemical properties, stability, antimicrobial activity, and comparative performance with conventional soap.

The **organoleptic properties** indicate that the formulation is a homogeneous, greenish-brown liquid with a pleasant herbal odor and smooth texture. The absence of particulate matter confirms proper mixing and uniform dispersion of ingredients, reflecting good formulation quality and aesthetic acceptability.

The **physicochemical parameters** reveal that the pH of the formulation lies within the range of 6.0–6.5, which is close to the natural skin pH. This ensures compatibility with the skin barrier and minimizes irritation. The moderate viscosity facilitates easy application and spreadability, while the formation of mild and stable foam indicates the presence of gentle natural surfactants such as Sapindus mukorossi. This suggests effective cleansing without excessive removal of natural skin oils.

The **stability study** demonstrates that the formulation remains stable under different storage conditions (4°C, 25°C, and 40°C) over 30 days. No significant changes in color, odor, pH, or phase separation were observed, indicating good physical and chemical stability and suitability for practical use.

The **antimicrobial activity** results show significant zones of inhibition against Staphylococcus aureus and Escherichia coli, along with moderate activity against *Candida albicans*. These findings confirm the effectiveness of the formulation in inhibiting common skin pathogens. The antimicrobial effect is primarily attributed to bioactive compounds such as flavonoids, alkaloids, and essential oils present in herbal ingredients like neem and tulsi.

The **comparative analysis** highlights that the herbal cleanser performs better than conventional soap in several aspects. Its near-neutral pH ensures better skin compatibility, while the presence of moisturizing agents such as aloe vera and glycerin helps maintain skin hydration. Additionally, the herbal formulation shows higher antimicrobial activity and lower irritation potential. In contrast, basic soap, with its alkaline pH, may disrupt the skin barrier and cause dryness upon prolonged use.

Overall, the data summarized in ***Table 4.1*** demonstrate that the herbal body cleanser offers a balanced combination of cleansing efficiency, antimicrobial protection, and skin-friendly properties, making it a safer and more effective alternative to conventional soap formulations.

Conclusion:

The present study successfully developed a herbal-based liquid body cleanser incorporating neem and tulsi extracts with significant antimicrobial properties. The formulation exhibited desirable physicochemical characteristics, including skin-friendly pH, good foamability, and stability. The antimicrobial studies confirmed its effectiveness against common skin pathogens. Additionally, the presence of natural moisturizing agents enhances skin hydration and reduces irritation.

Therefore, the developed herbal cleanser can be considered a **safe, effective, and eco-friendly alternative to conventional synthetic body cleansers**. Future work may include clinical evaluation and large-scale production studies.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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